REMARKS

The present amendment is in response to the Office Action dated December 1, 2006. Claims 1-49 are now present in this case. Claims 1, 10, 11, and 41 are amended.

Claims 1-5, 12-15, 21, 22, 29, 35-41, and 47-49 stand rejected under 35 U.S.C. § 102(b), as anticipated by a journal article by Thevenaz et al. The applicants respectfully traverse this rejection and request reconsideration. Thevenaz et al. describes a specific subpixel registration process with applications in medical imaging. However, Thevenaz et al., like other registration approaches known to the applicants, <u>always</u> performs a registration process on the imaging data. In Thevenaz et al., a two dimensional image <u>always</u> undergoes a two dimensional registration process and a three dimensional image <u>always</u> undergoes a three dimensional registration process. Nothing in Thevenaz et al. suggests a two dimensional registration process for a three dimensional image.

In contrast, claim 1 is directed to a method for adaptive registration of a set of three dimensional medical images. The method comprises "estimating an amount of patient motion corresponding to the set of medical images" as well as "selectively performing either a two dimensional image resampling or a three dimensional image resampling based on the estimated amount of patient motion." As noted above, Thevenaz et al. always performs a three dimensional image registration process on three dimensional medical images. As such, Thevenaz et al. does not teach or suggest any method which selectively performs <u>either</u> a two dimensional or a three dimensional image resampling based on the estimated amount of patient motion. For this reason alone, claim 1 is clearly allowable over Thevenaz et al. Furthermore, Thevenaz et al. does not perform a separate step of estimating patient motion. The three dimensional registration process for three dimensional images is always performed and patient motion is not separately determined. Rather, medical images in Thevenaz et al. are processed and registered. This registration process inherently corrects for patient motion, but does not result in any estimate of patient motion. For these reasons, claim 1 is clearly allowable over Thevenaz et al. Claims 2-14 are also

allowable in view of the fact that they depend from claim 1, and further in view of the recitation in each of those claims.

Claim 15 is also a method claim. Claim 15 recites *inter alia* "performing a three dimensional image resampling procedure in the event that the estimated amount of patient motion equals or exceeds the correction threshold" as well as "performing a two dimensional image resampling procedure in the event that the estimated amount of patient motion is less than the correction threshold." As discussed above with respect to claim 1, Thevenaz et al. does not teach or suggest any method that performs two dimensional or three dimensional resampling procedures based on a comparison between an estimated patient motion and a correction threshold. As noted above, Thevenaz et al. always performs a two dimensional registration process on two dimensional images and always performs a three dimensional registration process on three dimensional images. In addition Thevenaz et al. does not perform a separate estimation of patient motion or compare the patient motion with the correction threshold. The Office Action asserts that Thevenaz et al. describes the method of claim 15 at page 29, column 2-page 30, column 1. However, this is a misinterpretation of Thevenaz et al. The section recited by the Office Action relates to a measurement criteria by which the similarity between images may be determined. The similarity measurement criteria is described in the cited section of Thevenaz et al. However, this similarity measurement criteria is unrelated to patient motion and is not a correction threshold used to determine whether a three dimensional resampling procedure occurs, if the estimated patient motion exceeds the correction threshold or performing a two dimensional resampling, if the estimated patient motion is less than the correction threshold, as recited in claim 15. As noted above, Thevenaz et al. always performs a two dimensional image registration for two dimensional images and always performs a three dimensional image registration for three dimensional images. There is no correction threshold by which Thevenaz et al. selectively chooses two dimensional or three dimensional registration processes. Accordingly, claim 15 is clearly allowable over Thevenaz et al.

Claims 16-21 are also allowable in view of the fact that they depend from 15, and further in view of the recitation in each of those claims. For example, claim 21 recites the step of avoiding an image resampling process if the estimated patient motion

is less than the correction threshold by a predetermined amount. The Office Action, at page 3, asserts that it is inherent to "do nothing in the event that the estimation of motion is less than the correction threshold by a set amount." However, the registration process of Thevenaz et al. does not provide for the possibility of performing no registration. Thevenaz et al., as well as other registration processes known in the art, always perform a registration process. There is no determination that patient motion is small and that a registration process is necessary. In the case of Thevenaz et al., a two dimensional image always undergoes a two dimensional registration process. As noted above, this inherently corrects for any patient motion. However, nothing in Thevenaz et al. suggests that a two dimensional image might not undergo a registration procedure. Indeed, Thevenaz et al. describes no process by which patient motion is estimated at all. Any patient motion is inherently corrected via the registration process. This does not require a separate estimation of patient motion *per se*. Thus, claim 21 is clearly allowable over Thevenaz et al.

Claim 22 is also a method claim in which patient motion is estimated corresponding to the set of medical images and compared to a correction threshold. Claim 22 recites "performing an image resampling procedure in the event that an estimated amount of patient motion equals or exceeds the correction threshold and avoiding an image resampling in the event that the estimated amount of patient motion is less than the correction threshold." As discussed above with respect to claim 21, Thevenaz et al. always performs an image registration process. Thevenaz et al., like other prior art registration procedures, does not perform a separate process to estimate patient motion. Rather, image registration is always performed with the belief that image registration will inherently correct for patient motion and provide a better image. However, the applicants have found that in certain cases, patient motion is insignificant and image registration results in a degradation of image quality. Using the method recited in claim 22, it is possible to avoid image resampling if the patient motion is less than the correction threshold. Again, this is significantly different from the system in Thevenaz et al. which always performs a registration process. Thevenaz et al. does not estimate patient motion and then make a decision to perform a registration process, or not perform a registration process, based on a comparison between a patient motion

estimate and a correction threshold. Thevenaz et al. teaches away from this concept by always performing a registration process. As discussed above, there is no separate process to estimate patient motion. Rather, the registration process is believed to inherently correct for patient motion without ever having to actually estimate or measure patient motion. The so-called correction threshold mentioned in the Office Action is a measure of similarity between medical images. The similarity value may be used to terminate the registration process when the images are properly registered, but is not a correction threshold used to determine whether or not to initiate a registration process. Accordingly, claim 22 is clearly allowable over Thevenaz et al. Claims 23-28 are also allowable in view of the fact that they depend from claim 22, and further in view of the recitation in each of those claims.

Claim 29 is a system claim in which a computer readable medium contains instructions to cause the processing unit "to perform a comparison between an estimated amount of patient motion and a correction threshold" as well as selecting one from a group of "performing a first image resampling procedure, performing a second image resampling procedure, and avoiding an image resampling in accordance with a relationship between the estimated amount of patient motion and the correction threshold." As noted above, Thevenaz et al. does not actually calculate any estimated amount of patient motion. Rather, patient motion, if any, is inherently eliminated through the mandatory registration process performed by Thevenaz et al. In such a mandatory process, there is never an actual estimate of patient motion nor is there a need to compare an estimated amount of patient motion with the correction threshold. For this reason alone, claim 29 is allowable over Thevenaz et al. However, claim 29 is further distinguished from Thevenaz et al. by selecting one of three alternative procedures. That is, the system of claim 29 will perform either a first image resampling procedure, a second image resampling procedure, or no image resampling based on the relationship between the estimated patient motion and the correction threshold. Thevenaz et al. does not teach or suggest alternate correction procedures, or no correction procedure, based on such a relationship. If the image in Thevenaz et al. is a two dimensional image, Thevenaz et al. always performs a mandatory two dimensional registration process. There is no option to perform a three dimensional registration

process on a two dimensional image nor is there a suggestion of a process by which no registration occurs on a two dimensional image. With a three dimensional image, Thevenaz et al. always performs a mandatory three dimensional image registration process. There is no option in Thevenaz et al. to perform a two dimensional registration process nor is there a possibility of performing no registration process. Therefore, Thevenaz et al. does not teach or suggest any system by which no registration is performed or one of two alternative registration processes are performed based on the relationship between pick the estimated patient motion and a correction threshold. Accordingly, claim 29 is clearly allowable over Thevenaz et al. Claims 30-40 are also allowable in view of the fact that they depend from claim 29, and further in view of the recitation in each of those claims.

Claim 41 is directed to a computer readable medium in which program instructions cause a processor to "estimate an amount of patient motion corresponding to a set of medical images" as well as selecting "one from a group of performing a first image resampling procedure, performing a second image resampling procedure, and avoiding an image resampling in accordance with a relationship between the estimated amount of patient motion and the correction threshold." As discussed above with respect to claim 22, Thevenaz et al. does not calculate an estimated amount of patient motion that performs an iterative registration process until two images have sufficient similarity. The so-called correction threshold is merely a similarity measure between two images, but is unrelated to patient motion and is thus not an estimate of patient motion. Furthermore, Thevenaz et al. does not teach or suggest selecting from one of three alternative processes (performing a first resampling procedure, a second resampling procedure, or no resampling) based on the relationship between the estimated patient motion and the correction threshold. For at least this reason, claim 41 is allowable over Thevenaz et al. Claims 42-49 are also allowable in view of the fact that they depend from claim 41, and further in view of the recitation in each of those claims.

Claims 6-11, 16-20, 23-28, 30-34, and 42-46 stand rejected under 35 U.S.C. § 103(a) as unpatentable by a journal article by Thevenaz et al. combined with a journal article by Hill et al. The applicants respectfully traverse this rejection and

request reconsideration. The claims rejected under the combination of Thevenaz et al. and Hill et al. are all dependent claims. The inapplicability of Thevenaz et al. with respect to the various independent claims has already been discussed in detail. The addition of Hill et al. in combination with Thevenaz et al. does not overcome the serious deficiencies of Thevenaz et al. However, it should be noted that Hill et al. does not teach or suggest multiple registration processes that are selected on the basis of estimated patient motion. Indeed, Hill et al. is similar to Thevenaz et al. in that it describes an image registration system, but does not suggest estimating patient motion prior to a registration process. Indeed, patient motion *per se* is not estimated even as part of the registration process. Rather, the images themselves undergo a registration process that inherently corrects for patient motion without the need for ever performing an actual estimate of patient motion. In contrast, the method recited in, by way of example, claim 1, estimates the patient motion and selectively performs either a two dimensional resampling or a three dimensional resampling based on the amount of patient motion. The combination of Thevenaz et al. and Hill et al. do not suggest such a method. In another example, the method of claim 22 estimates patient motion and performs a comparison between estimated patient motion and a correction threshold. Based on the comparison, the method of claim 22 either performs a resampling procedure (if the estimated patient motion equals or exceeds the correction threshold) or avoids a resampling process (in the event that the estimated patient motion is less than the correction threshold). In sharp contrast, the combination of Thevenaz et al. and Hill et al. always perform a registration procedure. Therefore, there is no need to perform the separate task of estimating patient motion and comparing the patient motion with the correction threshold as a means of determining whether or not to perform a resampling procedure. That is, both Thevenaz et al. and Hill et al. always perform the registration procedure. Thus, there is no need in Thevenaz et al. or Hill et al. to estimate patient motion because there is no decision whether or not to perform a resampling procedure, as recited in claim 22. Other claims have similar distinctions. For the sake of brevity, those arguments need not be repeated herein.

In view of the above amendments and remarks, reconsideration of the subject application and its allowance are kindly requested. The applicant [has/have]

made a good faith effort to place all claims in condition for allowance. If questions remain regarding the present application, the Examiner is invited to contact the undersigned at (206) 628-7640.

Respectfully submitted,

Chris H. Wood et al.

Davis Wright Tremaine LLP

/Michael J. Donohue, Reg. #35,859/

Michael J. Donohue

MJD:gatc

2600 Century Square
1501 Fourth Avenue
Seattle, Washington 98101-1688
Phone: (206) 628-7640
Fax: (206) 903-3740

1924957_1.DOC